

Center for Integrative Coastal Observation, Research and Education

<http://cicore.mlml.calstate.edu/>

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The California State University Center for Integrative Coastal Observation, Research and Education (CICORE)

I. Introduction

The California State University (CSU) led California Center for Integrative Coastal Observation, Research and Education (CICORE), an applied coastal research center, began its third year of operations 1 August 2004. CICORE (<http://cicore.mlml.calstate.edu>) is dedicated to producing nationally relevant solutions to the many challenges facing our marine and estuarine environments through the creation of a distributed coastal observatory that addresses economically and environmentally important challenges such as coastal erosion, watershed impacts, chemical contamination of food webs, depletion of fish stocks, toxic plankton blooms, marine-borne pathogens, and the rapid invasion of coastal and estuarine waters by non-indigenous species. The CICORE program's primary goals are to provide (i) timely and appropriate environmental data and analyses to scientists, agencies and the public for policy development and the evaluation of the effectiveness of coastal and environmental policy and (ii) near real-time publicly accessible internet-based products developed from the observatory sensors.

II. Year-Three Objectives

The long-term CICORE objectives remain:

- 1) Establish research and monitoring infrastructure covering from the 100 m isobath into and onto the shore, including estuaries, wetlands, and critical coastal habitats in California, for integration into national and global ocean monitoring efforts.
- 2) Conduct research on problems that affect the economic and environmental well-being of California.
- 3) Develop models for predicting change in coastal environments.
- 4) Enhance management capability of regulatory and resource management agencies for sustainable use of the coastal zone.
- 5) Enhance public awareness of the importance of coastal management.

Year three objectives:

CICORE's year three plan emphasizes: data serving, product development and serving, integration with other programs to create a robust Regional Association (RA) focused on the coastal and watershed environment, and curriculum development. CICORE continues to expand with the inclusion of more CSU campuses, the development of new geospatial data streams, expansion of real-time and near real-time *in situ* data, and products derived from all these data sources. The goals can only be attained if CICORE partners collaborate with others to create vibrant California RAs.

Specific goals include a) benthic mapping and characterization of fisheries habitats, potential Marine Life Protected Areas and the NSF funded Long Term Environmental Research site in Santa Barbara Channel, b) hyperspectral and multispectral imaging of the potential Marine Life Protected Areas, Tomales Bay and Pt. Reyes, or the three California National Estuarine Research Reserves (NERR), c) continued expansion of the *in situ* sampling array and integration with non-CICORE sites and d) development of educational material related to the three observing technologies.

III. Achievements

This reporting period is for the second half (1 February 2005 – 31 July 2005) of year three, the first year that the program has received a funding level that allows the program to pursue its long term goals with a system-wide approach.

Program Management

The mission of CICORE Headquarters is to ensure the continuity of the program through sustained funding, the benefit to the public through coordinated data and product distribution, and the complementation, collaboration, and integration with other regional ocean observing systems. Headquarters is responsible for submitting semi-annual progress reports and annual proposals to NOAA. Headquarters and individual campuses have been successful in leveraging funds from other sources to augment Congressional funding. CICORE continues to participate in the development of four developing RAs: SCCOOS, CeNCOOS, NANOOS and PaCOOS (Southern California Coastal Ocean Observing System, Central and Northern California Ocean Observing System, Northwest Association of Networked Ocean Observing Systems, and Pacific Coast Ocean Observing System). Drs. Coale, Garfield and Kamer interface with the RAs and other regional ocean observing programs, and they serve as points of contact both within CICORE and for external entities.

Dr. Garfield represented CICORE and CeNCOOS at the Ocean Observing Meetings held in Washington DC in February 2005 and convened by Ocean.US. Strategies to develop a robust national ocean observing system were discussed, and the National Federation of Regional Associations was established. CICORE investigators held a meeting in April 2005 at Moss Landing Marine Laboratories. Topics discussed at the meeting included unveiling the new web site design, budgets, the 2005 data collection and processing schedule, ways to respond to NOAA's mandates, and strategies to strengthen program and outreach efforts. The Presidents Board met January 25 2005. They endorsed the 2004-2005 budget and voiced unanimous support for federal ocean observing initiatives.

Integration

CICORE fully recognizes and supports the need to organize coastal observing systems in a nationally coherent strategy and supports the efforts by Ocean.US and NOAA Coastal Observation Technology Section (COTS) to implement the Integrated Ocean Observing System (IOOS) goals through the creation of IOOS RAs. In California, CeNCOOS¹ and SCCOOS² are recognized as the two RAs and have received both organizational and observational support from NOAA. CICORE has been involved with these two RAs since their inception, particularly CeNCOOS.

Two of the five CeNCOOS Interim Executive Council members are CICORE principal investigators. The Council recently hired a new CeNCOOS coordinator following the departure of the previous coordinator and created an outreach and product development specialist position to provide regional outreach and product development coordination. CICORE provides support for these positions. The Council has also been working toward Executive Council elections in fall 2005. In addition, CICORE investigators serve on all four of the CeNCOOS subcommittees.

CICORE recognizes the importance of working with all RAs and COTS funded observatories in the development of a “standardized” web presence to enable efficient browsing and product recovery by users. Dr. Dale Robinson, San Francisco State University (SFSU), is the CICORE web coordinator and is a member of the COTS Common Interface Design Working Group. Dr. Robinson has been developing a new central CICORE web site that will have a greater degree of uniformity with existing IOOS web sites. Each CICORE member contributed general and site-specific content. CICORE investigators previewed the new design at their April meeting, and operation of the new site is anticipated for fall 2005.

Coastal Ocean Observatory

Six campuses now have in situ monitoring equipment, and several of these campuses have deployed more than one instrument package. In addition to the four campuses that previously comprised the distributed observatory (Humboldt State University (HSU), SFSU, Moss Landing Marine Laboratories (MLML) and Cal Poly San Luis Obispo (SLO)), CSU East Bay (CSUEB, formerly CSU Hayward) and CSU Long Beach (CSULB) have recently installed monitoring equipment. This extends the monitoring array into South San Francisco Bay and southern California. CSUEB deployed two instrument packages, one in San Leandro Marina and one in Berkeley Marina, and coordinated instrument deployment at a new site at the Dumbarton Bridge in San Francisco Bay with the USGS in August 2005. CSULB deployed an instrument package in LA Harbor and has secured equipment and permission for additional future deployments north and south of the Palos Verdes peninsula (Long Beach and Point Fermin).

MLML deployed a second instrument package in the Elkhorn Slough National Estuarine Research Reserve (NERR) in collaboration with the Alliance for Coastal Technologies (ACT).

¹ <http://cencoos.org/>

² <http://sccoos.org/>

Preparations have been made at SFSU for re-deployment of the instrument package now that construction on the pier is completed. Improvements to the infrastructure of the site were made with funds leveraged from the Romberg-Tiburon Center's (RTC) infrastructure budget. HSU has been making preparations for deployment of two more instrument packages locally. One deployment is planned for Trinidad Harbor and one for northern Humboldt Bay.

HSU and MLML have upgraded system software for real time streaming of water quality data to their websites. HSU, SFSU, MLML and Cal Poly SLO all have real time data posted on their websites. The current suite of parameters measured at in situ locations includes: temperature, depth, conductivity and/or salinity, dissolved oxygen, pH, turbidity, fluorescence (chlorophyll, chlorophyll a, and hydrocarbons), transmissometry, underwater irradiance, nutrients, phytoplankton, zooplankton and trace metals. MLML has also been developing software to serve historical water quality data in the same format as its meteorological historical data server, which allows the user to specify the time period and parameters to be displayed.

Meteorological data on the key forcing functions that drive coastal ocean dynamics are critical in interpretation of water quality data. HSU established collaboration with the National Weather Service (NWS), which has a station on Woodley Island in Eureka. The NWS is constructing a new meteorological tower on the north spit in Samoa with wind, temperature, and precipitation instrumentation. HSU CICORE purchased a relative humidity probe and a PAR sensor, and HSU's Dept. of Oceanography purchased a pyranometer; each of these will be added to the new station. The NWS will maintain the equipment and transmit the data in real time for display on the HSU CICORE website, which currently displays data from the existing NWS station. Cal Poly SLO is currently installing a meteorological station that will provide measurements of 10 meteorological variables. These installations will increase the number of CICORE meteorological stations to 4: HSU, SFSU, MLML, and Cal Poly SLO. The current suite of parameters measured by the meteorological stations includes: temperature, pressure, visibility, precipitation, wind speed and direction, dew point, relative humidity, and PAR.

High Resolution Seafloor Mapping

The CSUMB Seafloor Mapping Lab (SFML) has continued to develop its web-based delivery system for CICORE acoustic remote sensing data sets. The CICORE ArcIMS geodatabase (<http://seafloor.csumb.edu/arcims.htm>) and HTTP data delivery servers (<http://seafloor.csumb.edu/SFMLwebDATA.htm>) serve raster, vector and point GIS data products. The ArcIMS site enables the user to access and view GIS data layers interactively from any web browser or to add content as view-only layers to an ArcGIS project on their local machine. Once the user has identified the content that they need using ArcIMS, they can then retrieve the data files or full ArcGIS projects from the HTTP data delivery servers to their local computer. These servers continue to be populated for public dissemination of all multibeam and sidescan sonar products. The success of these CICORE services has led to their becoming the model system for several other state and federal initiatives to serve coastal marine data (California Department of Fish and Game, and National Marine Sanctuary System). Access to the SFML CICORE sites can be found at: <http://seafloor.csumb.edu/CICORE/cicorenewv2.html>

CICORE partners selected Humboldt Bay as a testing ground for the development of GIS tools that integrate hyperspectral and multibeam bathymetry data sets to facilitate habitat classification in nearshore areas too shallow for sonar surveys. A diverse and intensely collaborative array of stakeholders, researchers, and local, state and federal resource agencies share a critical need for accurate Humboldt Bay bathymetric, habitat and plant cover data, particularly eelgrass. The depth range (intertidal to shallow subtidal) and low water clarity of Humboldt Bay require the use of aerial optical and vessel-based acoustic sensors to accurately map the elevation and vegetation cover of the entire bay; the CICORE program is uniquely suited for this task.

The SFML completed its planned CICORE multibeam and single-beam acoustic hydrographic surveys of Humboldt Bay in July 2005. These results will be fused with those from the previous CICORE hyperspectral flights (October 2004) and existing Army Corps of Engineers sonar data and Humboldt Bay Harbor District LIDAR data to produce a comprehensive bathymetric and habitat map of Humboldt Bay. Preliminary results are shown in Figure 1. The final CICORE product will be used to show and predict the distribution of eelgrass beds and habitat within the bay, based on elevation and CICORE water quality monitoring data.

In May 2005, the SFML began working with USACE and USGS on beach replenishment at Ocean Beach in San Francisco Bay. The SFML is monitoring the movement of sediment from the experimental dredge spoil dump site toward or away from the eroded portion of Ocean Beach.

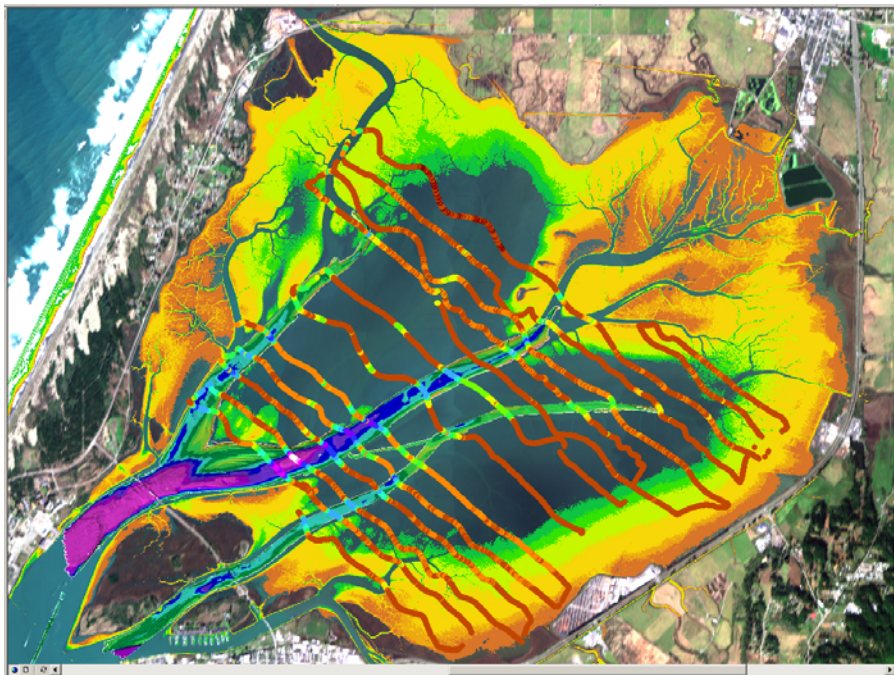


Figure 1. Preliminary bathymetric data fusion product for northern Humboldt Bay. Colors indicate elevation in NAVD88 (warmer colors higher, cooler colors lower). Data sets include multibeam bathymetry (deeper channels), singlebeam bathymetry (narrow tracks running across entire bay), LIDAR (shallow intertidal areas around perimeter of bay), all superimposed on the CICORE hyperspectral image, which clearly shows additional topographic structure in the central bay not covered by the other sensors.

Hyperspectral Imaging (HSI)

The Florida Environmental Research Institute (FERI) has completed the Phase III calibration, atmospheric correction, and ortho-rectification of all hyperspectral images from the fall 2004 field campaign. The Phase III calibration and atmospheric correction is an iterative process by which lines of known atmospheric absorption and illumination are used to check the veracity of spectral and radiometric calibration. The positioning accuracy in the Phase III ortho-rectification of the hyperspectral images has improved significantly through collaboration with Trimble/Appplanix Integrated Solutions Group. The high precision POS-AV IMU/INS system, coupled with the new software ability to ortho-rectify the imagery, provided an enhancement in positional accuracy to within a pixel on average. This improvement in positional accuracy was demanded by the HSI user base because it is critical for the time-dependent change analysis in shallow water and wetlands systems.

Old Dominion University (ODU) in Virginia has been working with FERI to finalize the hyperspectral imagery collected in fall 2004. ODU will begin developing data products of kelp abundance and condition once the imagery has been fully calibrated. ODU has also been testing the utility of deploying the HTSRB and profiling Hyperpro in tandem to get values of $K(L_w)$ that can be used to rapidly estimate water leaving radiance (L_w), which is needed to determine remote sensing reflecting (R_{rs}) at the sea surface. R_{rs} is the key parameter needed for atmospheric correction.

The San Diego State University (SDSU) Center for Hydro-Optics and Remote Sensing (CHORS) has combined the fall 2004 hyperspectral imagery of San Diego Bay and Long Beach Harbor with, and compared to, remote sensing reflectance and inherent optical properties (absorption, scattering and backscattering) measured *in situ* at each site. Results of preliminary analyses of these data, emphasizing water transparency and diver visibility determinations, were reported in Trees et al. (2005):

Trees, C.C., P.W. Bissett, H. Dierssen, D.D.R. Kohler, M.A. Moline, J.L. Mueller, R.E. Pieper, M.S. Twardowski and J.R.V. Zaneveld. 2005. Monitoring water transparency and diver visibility in ports and harbors using aircraft hyperspectral remote sensing. In: M.J. DeWeert and T.T. Saito [Eds.], *Photonics for Port and Harbor Security*, Proc. SPIE Vol. **5780**: 91-98.

FERI hosted two graduate students from CSU programs in order for them to complete their training in the use of HSI data and image processing. Mike Sauer, from Cal Poly SLO, used the HSI data stream for advanced image processing techniques and wetlands classification in Morro Bay. Mike developed novel approaches to reduce noise in the PHILLS 2 imagery. This allowed him to accurately match the HSI data with the spectral library of eelgrass, pickleweed, saltgrass and a number of substrates, mud, sand etc. collected concurrently with the overflights in November, 2004. Mike was then able to develop classification schemes for indicator species and communities (Figure 2), which may be changing as a function of sediment loading into the wetlands. These data will be provided to the Morro Bay National Estuary Program (MBNEP) for their GIS base maps and ongoing estuary monitoring efforts. Ultimately, Mike's work will lead to species maps and biomass estimates for salt marsh species in Morro Bay. FERI is

implementing these noise reduction techniques in the processing of all of the PHILLS 2 data from CICORE (nearly 10,000 sq. km. of HSI data) and will make these data available in the next CICORE data revision.

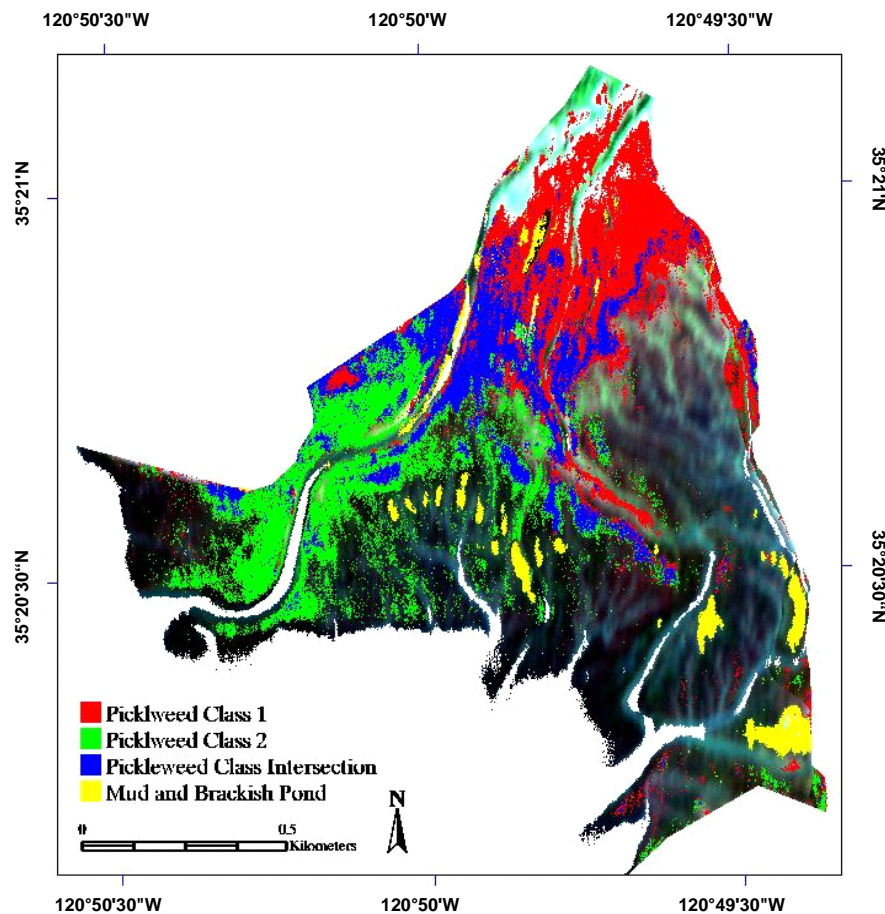


Figure 2. Spectral classification of pickleweed in the salt marsh of Morro Bay from a hyperspectral image collected in November, 2004. Gradients in environmental factors, such as temperature and salt exposure, can produce unique spectral signatures within a single species.

Chaeli Judd, from HSU, is combining HSI data with other data streams in a GIS format to produce better eelgrass classification maps than have been previously produced with color-infrared imagery. Chaeli fused HSI data with Humboldt Bay topographic LIDAR data collected in 2002, when the tidal stage was below MLLW, and modeled tidal data from October 27, 2004, the date of the HSI collect, to produce water height above bottom maps. Chaeli was then able to reclassify previous survey data that had incorrectly identified macroalgae as eelgrass, thus providing a more accurate baseline against which future change can be assessed. Chaeli created a presentation of these preliminary data for the August 2, 2005 Humboldt Bay CICORE and CeNCOOS Users Meeting.

FERI is recognized as a leader in dark target imaging spectroscopy, in a part because of its CICORE efforts. This recognition has led to the proposed effort by NOAA Coastal Ocean

Application and Science Team (COAST) to begin the GOES-R Risk Reduction Plan in Monterey Bay in fall 2006. The NOAA GOES-R effort is one of the latest ocean color satellite efforts focused strictly on the coastal ocean, and FERI's CICORE efforts have been prominently focused in the development of the scientific and operational mission. FERI has also been selected as the provider of high altitude HSI data through 2009, which will simulate the anticipated GOES-R Hyperspectral Environmental Suite – Coastal Water (HES-CW) sensor.

Education and Outreach

CICORE's outreach and education efforts increased significantly during this funding period. In particular, Dr. Frank Shaughnessy of HSU has been responsible for a number of these efforts:

- Presentation by Dr. Shaughnessy about the CICORE program and its outreach efforts to SACER (Scientific Advisory Council for Estuarine Restoration), which is a local recommending body.
- At the Humboldt Bay Symposium in March 2005, Dr. John Largier of Bodega Marine Lab used CICORE water quality data to discuss the physical oceanography of Humboldt Bay. People were very impressed with the existence of these data and the presentation itself.
- In April, Dr. Shaughnessy distributed an outreach letter (Appendix A) to the 130 people who attended the Humboldt Bay Symposium in March, 2005, as well the faculty, staff and graduate students within the HSU College of Natural Resources and Sciences. The letter described the purpose of CICORE, its' data products and how they could be used, listed web sites where the data can be accessed, outlined upcoming local program efforts and provided program contact information. Website tracking indicated that this letter resulted in a large number of 'hits' to the site.
- HSU CICORE technician Kathleen Williamson trained people from the community in the calibration of Yellow Springs Instruments data loggers. These other people are also measuring water quality in Humboldt Bay, and they are posting their data on the HSU CICORE website.
- The entire HSU CICORE team, including students, prepared for the August 2, 2005 CICORE and CeNCOOS Users Meeting held at HSU (Appendix B). Assisting with preparations were Dr. Rikk Kvitek (CSUMB SFML), Dr. Paul Bissett (FERI), Dr. Toby Garfield (SFSU), Dr. Krista Kamer (MLML) and Ms. Rondi Robison, the outreach and product development specialist for CeNCOOS.
- HSU has been successful in its efforts to integrate CICORE activities with the surrounding community, particularly for in situ water quality and meteorological monitoring. The following groups are providing building space, labor, equipment, data, or a combination of these: CA Sea Grant, City of Eureka, Table Bluff Reservation – Wiyot Tribe, National Weather Service – Woodley Island, City of Trinidad, and the Trinidad Rancheria (the Yurok, Wiyot, and Tolowa peoples). Several of these groups are now posting their water quality data through the HSU CICORE website, which is becoming the primary local hub for access to these kinds of data. Coast Seafoods Company (mariculture) and the Humboldt Bay Harbor District also provided vessel, labor and slip resources to support the CICORE acoustic sampling in the bay that occurred during July 2005.

- The HSU CICORE website has a “Contact Us” comment link. Via this link, HSU CICORE has received feedback from the community confirming the importance and usefulness of the data collected (Appendix C).

Additional outreach and education efforts have been made by the other CICORE members. The technologies that CICORE has developed are a central part of a new course developed at Cal Poly SLO called *Ocean Discovery Through Technology*. This course is a General Education course open to all students on campus and fulfills the Technology requirement. The course is designed around understanding new technologies, how they are brought to bear on coastal oceanography, and what the new instrumentation and technology allow us to do with respect to resource management and habitat assessment in the context of human use and impact. The three primary CICORE technologies (high-resolution seafloor mapping, HSI, and in situ water quality monitoring) are highlighted, and students get hands-on experience in the field and laboratory. Dr. Mark Moline taught the course in 2005.

Two Cal Poly SLO CI-CORE graduate students have been supported by CICORE to generate a spectral library in collaboration with the MBNEP. In preparation and training, CICORE provided the funds for the students to attend a two-week optics course at the University of Maine, an IDL ENVI training workshop and an IDL programming course. The students actively worked with the MBNEP to transition the HSI imagery products into GIS products that are presently being used for management of the Bay. Cal Poly and FERI have collaborated to start an internship arrangement for the students to get the hands-on training; this effort proved successful during June and July of 2005.

Preparations have been made for deployment of two instrument packages north and south of Palos Verdes peninsula by CSULB. The *in situ* monitoring data collected will be displayed in real time at the two local aquariums, Cabrillo Marine Aquarium and the Aquarium of the Pacific. Deployments are anticipated for fall 2005. CICORE students will be involved with providing public interpretation and training aquarium staff.

Dr. Dale Robinson (SFSU) participated in the EARTH workshop held at MBARI in July 2005. High school teachers from around the country interacted with education experts and representatives of the scientific community to develop curricula that bring ocean observing into the classroom.

SFSU has collaborated with Sun Microsystems and Agilent Technologies to develop a wireless communication and storage system for real-time reporting of monitoring data; Sun Microsystems and Agilent Technologies funded the project. The system (netBEAMS) is fully operational and real time data, derived from the CICORE site in San Francisco Bay (SFBEAMS), may be accessed at <http://www.netbeams.org/>. Two graduate students are supported by the project and the data base is being assessed for CICORE operational use.

SFSU is also assisting the San Francisco Bay National Estuarine Research Reserve (NERR) in construction and installation of meteorological stations at their field stations in San Francisco Bay. This data will be publicly available through CICORE and NERR. SFSU is also developing automated and manual QC procedures for real time and archived datasets.

CSUEB is coordinating an instrument deployment at a new site at the Dumbarton Bridge in San Francisco Bay with the U.S. Geological Survey. CSUEB also recently worked with researchers from San Francisco Estuary Institute and California Department of Boating and Waterways on a CALFED-funded study. Eight students from CSUEB participated directly in CICORE research during the period of this report. They assisted with service runs and instrument deployments, and were trained in calibration and maintenance of water quality sondes.

Sample of collaborators

US Geological Survey
US Army Corps of Engineers
National Weather Service
NOAA Alliance for Coastal Technologies
National Estuarine Research Reserves (NERR): San Francisco Bay, Elkhorn Slough and
Tijuana Estuary
National Marine Sanctuaries: Cordell Bank, Gulf of the Farallones, Monterey Bay and
Channel Islands
California Regional Water Quality Control Boards
California SeaGrant
California Department of Boating and Waterways
Monterey Bay Aquarium Research Institute
San Francisco Estuary Institute (SFEI)
Humboldt Bay Harbor District
Indian tribes: Table Bluff Reservation- Wiyot Tribe, Trinidad Rancheria
Local governments: City of Eureka, City of Trinidad
Cabrillo Marine Aquarium
Aquarium of the Pacific
Sun Microsystems
Agilent Technologies
Coast Seafoods Company

Sample of known data and product users:

US Army Corps of Engineers
US Fish & Wildlife
US Coast Guard
National Marine Fisheries Service
Bureau of Land Management
California Department of Fish & Game
California Coastal Commission
California State Parks
Humboldt County Division of Environmental Health
University Students- HSU, College of the Redwoods
Hayward High School
Humboldt Bay Harbor District
Humboldt Bay Stewards

IV. Summary

CICORE continues to have a significant impact along the California coast and has made major advances in implementation of the articulated long term goals during this six month period. We have expanded the geographic extent of our in situ water quality and meteorological monitoring arrays, which compliment other in situ arrays and provide critical baseline data in sensitive coastal environments. We have also improved automated processes to post data on the internet in real time. Data collected by the CSUMB SFML and FERI are available to the public through a variety of web servers. Integrated products that fuse a variety of data types are being developed and user input helps guide this development. CICORE data have been used in seminars, workshops, undergraduate and graduate classes, and undergraduate and graduate students participate in CICORE research. Graduate students have used CICORE data in their theses and have acquired skill sets attractive to potential employers. Myriad collaborations have been formed and data/product users have been identified and contacted.

APPENDIX A
Humboldt State University Outreach Letter



14 April, 2005

Dear CNRS Faculty, Staff & Students,

I'd like to update you on recent CICORE (Center for Integrative Coastal Observation, Research and Education) activities so that you can put the data we are collecting to use in private industry, resource management, scholarship, or in the classroom. CICORE is a group of NOAA funded California State University campuses whose mission is to provide water quality and habitat map information for estuarine and coastal locations, which are areas that receive less attention from other ocean observation organizations. Humboldt State University is the northernmost location in this collective effort.

CICORE efforts through HSU have focused on Humboldt Bay. You can go to <http://cicore.humboldt.edu> and either generate water quality graphics or download a file of these data (i.e. tidal elevation, water temperature, salinity, dissolved oxygen, pH, turbidity, chlorophyll), which have been recorded almost every 15 minutes since June 2003 by a Yellow Springs Instruments sonde. This instrument is located on Dock B and data recorded on the flood tide are describing primarily oceanic water whereas values during the ebb tide describe the water receding from the east side of Arcata Bay and Freshwater Creek. Monthly sampling and description of the fish community in an eelgrass bed off of Somoa is also being conducted.

The second effort in Humboldt Bay, which was initiated during October, 2004 by CICORE and its partner (<http://www.feriweb.org>), is the production of a file containing high-resolution image data of the bay and the surrounding uplands. This file can be used to map the distribution of eelgrass, mudflat and high marsh habitats within the bay when used in conjunction with image analysis software. This spatial information is being created from airborne imagery collected with two sensors. The first one is a medium format digital frame camera with 3 different wavelengths to produce an RGB image of the Bay at ~50 centimeter resolution. The second sensor is a hyperspectral line scanner, which collects 124 wavelengths to produce an image "cube" (2 spatial dimensions, 124 spectral dimensions) of the Bay at ~3 meter resolution. The RGB camera produces aerial imagery similar to that found in other studies; however, the hyperspectral sensor is unique in allowing us to peer through the water to different depths, based on the water clarity, to retrieve bottom habitat information. An image of the area remotely sensed during October can be found at http://cicore.humboldt.edu/?content=data_oct2004imagery&menu=menu2, and this particular hyperspectral effort was able to reach depths from 1.5 to 4.0 m. The actual ortho-rectified file, which is > 50 GB in size, could be used at this time to produce a habitat map but the quality of the imagery data will be improved during summer 2005 when spectral signatures will be obtained for the main substratum types in the bay. Faculty and students at HSU are just beginning to produce habitat maps from this data, which will eventually be posted on our website since we understand that many users would rather access a finished habitat map.

Future northern activities of CICORE include making the Humboldt Bay spatial data set even more valuable by combining sonar and the hyperspectral data to produce high resolution, high quality bathymetry for the shallower sections of the bay. These ecologically important areas are not surveyed by the Army Corps of Engineers. The CICORE bathymetric work this summer is being supported in part by the Harbor District and Coast Seafoods. The ability to fuse imagery and all the bathymetric data together is exciting because of what it will reveal about the structure of the different habitats in and around the bay. Other future CICORE activities in Humboldt County include the addition of at least one more sonde to the bay, and we hope to place another one on the Trinidad pier. Water quality data are currently uploaded to the website monthly but our highest priority is to accomplish realtime data transfer for at least the Dock B sonde.

The water quality, imagery data, and future habitat maps have no value unless you use them. Although they are free, future funding to CICORE depends upon you sending us an email message from <http://cicore.humboldt.edu/?content=email&menu=menu5> that very briefly describes how you used the data. *Please do so.* CICORE is also interested in assisting you with new projects, in which case you will be expected to provide some of the support. If you would like to discuss the possibility of a project in northern California, or any other aspect of the HSU CICORE program, then please email me (fjs3@humboldt.edu). Dr. Greg Crawford, Dr. Steve Steinberg, Dr. Tim Mulligan, Ms. Kathleen Williamson, Mr. Matthew Perry and I hope these data further your understanding of our coastal environments.

Sincerely,

Frank J. Shaughnessy, PhD
Associate Professor of Botany

fjs3@humboldt.edu
Department of Biological Sciences

APPENDIX B
CICORE and CeNCOOS Users Meeting Announcement



Humboldt CICORE & CeNCOOS Users Meeting

CICORE (Center for Integrative Coastal Observation, Research & Education) and CeNCOOS (Central & Northern California Ocean Observing System) invite you to a meeting for the purpose of having you explain your management, research and education needs so that our two organizations can better meet them. After providing background about ocean observation efforts at regional and local levels, we will convene work group sessions on our water quality and habitat map products, and then the entire group will get together again in order to summarize how we will address your needs. Please feel free to visit the web sites of Humboldt State University CICORE (<http://cicore.humboldt.edu/?content=home>) and CeNCOOS (<http://www.cencoos.org/>).

The meeting will be held on Tuesday, August 2, 2005 from 8:30 – 5:00 on the Humboldt State University campus in Arcata, California in Science building B, Room 135. Although there are no fees for attending this meeting, we ask that you register online (<http://cicore.humboldt.edu/?content=events>) so that we can develop a mailing list for sending you additional meeting information; you also need to register so that we can arrange a free parking pass for you. We are providing coffee and lunch.

Meeting Schedule

8:30 – Coffee, etc. (Science B Lobby)

Ocean observation, CICORE & CeNCOOS (Science B, Rm. 135)

9:00 – 9:10, Meeting Introduction: Frank Shaughnessy (fjs3@humboldt.edu)

9:10 – 9:35, CeNCOOS & the Regional Ocean Observation Perspective: Rondi Robison (rrobison@ucsc.edu)

9:35 – 10:00, Structure & Objectives of CICORE, COCMP, ACT: Toby Garfield (garfield@sfsu.com)

10:00 – 10:15, Value of CICORE: President Rollin Richmond (rollinr@humboldt.edu)

10:15 – 10:30, Break

Local CICORE & brief session introductions (Science B, Rm. 135)

10:30 – 10:35, Humboldt CICORE & Session Introductions: Frank

10:35 – 10:40, Water Quality: Kathleen Williamson (kafiend@aol.com)

10:40 – 10:50, Habitat Mapping: Rikk Kvitek (rikk_kvitek@csumb.edu) & Paul Bissett (pbissett@flenvironmental.org)

Breakout session on habitat mapping (Science B, Rm. 135)

11:00 – 12:00, Rikk, Paul, Chaeli Judd (crj10@humboldt.edu)

Breakout session on water quality (Science B, Rm. 133)

11:00 – 12:00, Kathleen, Rebecca Studabaker (rss15@humboldt.edu) & Mike Gough (mogough@sbcglobal.net)

12:00 – 1:30, Lunch at Cypress Bowl (upper HSU campus)

1:30 – 2:30, Breakout sessions reconvene as necessary

Whole Group Reconvenes (Science B, Rm. 135)

~ 2:30 – 3:30, Session reports & group discussion

~ 3:30, Closing remarks: Frank

~ 3:35, Coffee

Area Transportation & Accommodations

The address http://studentaffairs.humboldt.edu/parents/lodging_transportation.php will take you to a site for the parents of HSU students that contains links to most of the areas lodgings and modes of transportation. The lodging prices quoted are lower than what you will pay, and not all of them have modems or dataports.

Getting to Humboldt State University

Notice: The below instructions also describe where to obtain the free (only if you register) parking permits. You will need to identify yourself as an attendee of the "CICORE meeting". The last page of this document shows the locations of the parking lots as well as the meeting and lunch locations. *Parking on the HSU campus is very limited at this time*, and so we recommend arriving no later than 8:15. Handicapped parking is available adjacent to the Science building complex.

Driving Directions from the North, via Highway 101:

Go south on 101 to the Sunset Avenue freeway exit in Arcata. From the stop sign, turn left over the freeway, then turn right onto L.K. Wood Boulevard. Proceed two blocks to Harpst Street; turn left. You'll see our Parking Services kiosk on your right where you may obtain a parking permit and parking instructions.

Driving Directions from Sacramento/Redding:

Drive north on Interstate 5 to Williams; take Highway 20 west, then Highway 101 north to Arcata. In Arcata, take the 14th Street Exit. At the stop sign, proceed straight (paralleling the freeway) one block; turn right on Harpst Street. You'll see our Parking Services kiosk on your right where you may obtain a parking permit and parking instructions. Total driving time is approximately 5 1/2 - 6 hours.

Alternate Route via Redding:

Drive north on Interstate 5 all the way to Redding; turn west on Highway 299 (there are some twisty mountain stretches of road here and chains may be required in the winter). Upon arrival at the coast, turn south on Highway 101. Go south on 101 to the Sunset Avenue freeway exit in Arcata. From the stop sign, turn left over the freeway, then turn right onto L.K. Wood Boulevard. Proceed two blocks to Harpst Street; turn left. You'll see our Parking Services kiosk on your right where you may obtain a parking permit and parking instructions. Total driving time from Sacramento to Redding is 2 1/2 - 3 hours; from Redding to Arcata is approximately 3 hours.

Driving Directions from the San Francisco Bay Area:

Drive north on Highway 101 to Arcata. In Arcata, take the 14th Street Exit. At the stop sign, proceed straight (paralleling the freeway) one block; turn right on Harpst Street. You'll see our Parking Services kiosk on your right, where you may obtain a parking permit and parking instructions. Total driving time is approximately 5 - 6 hours.

Driving Directions from the Los Angeles/San Diego Area:

Drive north on Interstate 5 to 580; head northwest to Highway 101. Drive north on Highway 101 to Arcata. In Arcata, take the 14th Street Exit. At the stop sign, proceed straight (paralleling the freeway) one block; turn right on Harpst Street. You'll see our Parking Services kiosk on your right, where you may obtain a parking permit and parking instructions. Total driving time from the Los Angeles area is approximately 12 hours.

APPENDIX C
Comments on HSU CICORE Website

Comments submitted through the HSU CICORE website:

- “Frank Shaughnessy referred me to the site. I was looking for movement of phytoplankton blooms and this turned out to be a great resource. Thanks...” [Sent in by a person looking for evidence of Pseudo-nitzschia blooms.]
- “The data collected by CI-CORE are very useful in research efforts, both collaborative with CI-CORE investigators (anticipated) and in comparing Humboldt Bay with other bays in coastal upwelling regions. Thank you for making these data available - they are likely to enhance and enable quite a bit of research in the Bay.” [Sent in by a person doing some physical oceanography research on Humboldt Bay.]
- “I used the interactive map to zoom in on proposed replanting sites for off-bottom aquaculture and also used the low tide image to see which sites would be submerged at low tide in order to assess potential effects on listed salmonids. The photos showed the small tidal channels in the proximity of the oyster culture indicating likelihood that organisms could follow the tidal flow up into the culture structures. It was so easy and clearly demonstrates potential effects that are difficult to envision from a mere map. This has been invaluable to me.” [Sent by a person from NMFS]
- “Hi All, Once again I am looking at the turbidity data in order to obtain a sense of "background" conditions and how they relate to expected magnitude and duration of turbidity as a result of suspension of sediment during maintenance dredging of 11 sites in the vicinity of the Eureka Channel (including adjacent to Dock B!) in late 2005-early 2006. I hope the Corps will inform their permit applicants so that the applicant can provide more detailed and data based assessments. Looking forward to participating on August 2...” [Sent by a person from NMFS]
- “I find your Humboldt Bay water quality data posting a valuable resource for comparing with other data sources. Specifically, I have compared the continuous turbidity data for the Dock B site with turbidity data I collect on Jacoby Creek, a Humboldt Bay tributary. I would like to collaborate on future data collection, including placement of the second unit planned for deployment.” [Sent by a private consultant doing monitoring of the watersheds draining into Humboldt Bay.]

Emails sent directly to Frank Shaughnessy:

- “Hi Frank, thanks for the email message. I have taken a preliminary look at your Dock B turbidity data and compared it with my turbidity record for Jacoby Creek. Although the two don't always track very closely, there are some interesting trends I'd like to discuss with you. Also, if you are interested in locating the second sensor in a location that might relate more closely with freshwater sediment inputs, I could help. On another issue, we are presently monitoring slough channel water levels on the inland side of a broken tide gate just north of Jacoby Creek along Highway 101. This is to quantify the muted tidal response to the tide gate failure to help calibrate a numerical model that we will be using for a tidal

restoration project nearby. Your Dock B water level info may prove useful for this, in addition to the other tide gages in the bay. Thanks..." [Sent by a private consultant doing monitoring of the watersheds draining into Humboldt Bay.]

- "Frank, Thank you for your friendly and prompt response. I apologize for taking so long to answer you. We are working on several projects here at Redwood Community Action Agency that could benefit from the mapping of several characteristics of Humboldt Bay. Currently, are engaged in the Humboldt Bay Water Quality Improvement Program (HBWQIP) through which we will be producing a monitoring and existing conditions report for the State Water Resources Control Board. We are the staff involved with the projects of Humboldt Bay Watershed Advisory Committee (HBWAC) as well as the Bay Stewards, and will possibly be collaborating with Humboldt Bay Keeper on various efforts. I see the potential for these projects and organizations, as well as future projects funded by the CA Department of Fish and Game and the State Coastal Conservancy, to benefit from the use of the CICORE imagery...I did quite a lot of signature development and image classification when I was a grad student at HSU working with Larry Fox so I am familiar with the concepts. I would like to try to develop some signatures for various sediments, eel grass, algae, and various toxins and pollutants. I would be using ESRI software which is not primarily image processing software but it does have that functionality. I am curious as to why you are going to use ENVI rather than (Leica) ERDAS Imagine. Anything you can tell me about this would be helpful. Thank you very much..." [This person is doing HBay image analysis for the nonprofit group Redwood Community Action Agency; RCAA. This email was part of a long string with other CICORE personnel who were quite helpful to this person.]
- "Hello Frank, I just remembered to remind you that SeaGrant and CDFG used CICORE data for our presentation at the PERS conference in Charleston Oregon on March 19th-20th, 2005. We even gave CICORE a plug and expressed the hope we would be getting more sondes in the near future." [From a graduate student working for SeaGrant and doing eelgrass research.]
- "Frank, really cool site but I'm afraid I may need a direct line to you. Nothing less than a red phone at your side will do. I have questions that I can't seem to answer myself. Why is recent DO so much lower than it has been in the last year? Where is the recent Chlorophyll data? I will access this daily and find it extremely useful. Thanks again." [From one of the local oyster growers.]